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Cross-Country Empirical Studies of Systemic Bank Distress:

A Survey

by

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Abstract

A rapidly growing empirical literature is studying the causes and consequences of bank fragility in contemporary economies. The paper reviews the two basic methodologies adopted in cross-country empirical studies, the signals approach and the multivariate probability model, and their application to study the determinants of banking crises. The use of these models to provide early warnings for crises is also reviewed, as are studies of the economic effects of banking crises and of the policies to forestall them. The paper concludes by identifying directions for future research.

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1. Introduction

Until recently, research on banking crises was inspired mostly by the experiences of the 19th and early 20th century. In particular, the field was dominated by studies of the Great Depression, when numerous and catastrophic bank failures occurred around the world.[1] Beginning in the 1990s, a resurgence of banking crises provided new impetus and new materials to researchers, and a rapidly growing literature is studying the causes and consequences of bank fragility in contemporary economies. This paper surveys this work and tries to highlight directions for future research.

The paper is organised as follows: the next section reviews the basic facts about the recent wave of financial crises. Section 3 presents the two basic methodologies adopted in cross-country empirical studies of the determinants of banking crises, and Section 4 discusses how these models have been used for crisis prediction. Section 5 reviews the literature and evidence on how various factors contribute to bank fragility. Section 6 surveys work on the economic effects of banking crises. Section 7 concludes by pointing to some of the issues that further research could usefully focus on.

2. The resurgence of financial instability in the 1990s

Following the financial disasters of the 1920s and '30s, the postwar years marked a return to economic and financial stability, and banking crises were rare and isolated events. A calm macroeconomic environment, favourable economic growth, low inflation, and pervasive controls on international capital flows contributed to financial stability. Also, in many countries, including the more free-market oriented ones, bankers' freedom of action remained severely restricted by watchful central banks, wielding a wide array of regulatory powers to control the quantity and price of credit.

Following the breakdown of the Bretton Woods system and the first oil shock, macroeconomic stability became elusive. But even during the turbulent 1970s the banking sector remained sound in most countries, perhaps thanks to the low (indeed negative) real interest rates and the persistent regulatory straightjacket.

Once lax monetary policy was abandoned, real interest skyrocketed, and credit markets began to be liberalised in the early 1980s, several financial crises broke out in Latin America and other developing countries, often accompanied by widespread bank distress. Most explanations for these crises, however, focused on fiscal profligacy, external shocks, and exchange rate policy as the main culprits, while bank fragility continued to garner little attention. An important exception was Diaz-Alejandro's (1985) masterful account of the Chilean crisis. As the title unambiguously indicates (Goodbye financial repression, hello financial crash), this paper traced the roots of the Chilean crisis directly to the banking system and its botched privatisation in the late 1970s.

If bankers might have been innocent by-standers during the LDC debt crises of the 1980s, this was certainly not the case in the US Savings and Loans debacle which unfolded during the same period. This episode demonstrated how the erosion of bank capital following financial liberalisation, generous deposit insurance, and ineffective regulation could conspire to make gambling and looting an optimal business strategy for scores of bank managers (Kane, 1989; Akerlof and Romer, 1993). Though US tax-payers eventually shouldered a large fiscal cost, the macroeconomic effects of the S&L episode were negligible.

With the arrival of the 1990s, financial crises in which the banking sector played centre stage and macroeconomic consequences were sharp and – at times – protracted, became more and more widespread. In the Scandinavian countries currency devaluation and falling asset prices caused banking crises and economic slowdown (Drees and Pazarbasioglu, 1998). In Japan the collapse of the asset price bubble rendered most of the banking sector

insolvent, though open bank failures remained rare. Regulatory forbearance and lax monetary policy allowed the process of balance sheet repair to stretch over more than a decade, and banks continued to finance poorly performing firms (Hoshi and Kashyap, 2004). After over 40 years of rapid expansion, Japanese growth ground to a halt in 1992, and has yet to recover.

The crisis that perhaps contributed the most to put bank health squarely on the list of the key components of macroeconomic stability was the Tequila crisis, which began in Mexico in December 1994. In contrast to the earlier Latin American experiences, before the crisis the Mexican Government finances appeared mostly sound. Nonetheless, the combination of a faltering banking system, dollar-denominated debt, and political shocks resulted in the devaluation of the currency and financial meltdown (see, for instance, Calvo, 1996, and Edwards and Végh, 1997). Eventually, the cost of bailing out the banks reached almost 20 per cent of GDP; despite the generous rescue, bank credit to the private sector and economic growth in Mexico remain lacklustre to this day.

If the Tequila episode had left any observer in doubt about the dangers of bank fragility, the East Asian crises of 1997–8 drove the point home; even economies with sound public finances and a spectacular growth record could be brought to their knees within a few months, as banks buckled, depositors lost confidence, asset prices collapsed, and foreign capital inflows evaporated (see, for instance, Lindgren *et al*., 1999).

The banking crises of the 1990s spurred numerous case studies, some descriptive and some econometric, of specific banking crisis episodes, as well as several attempts to draw generalisations from individual experiences.[2] They also stimulated more systematic efforts to assess bank fragility around the world. In 1996 the IMF and the World Bank published comprehensive studies of bank distress in their member countries (Lindgren, Garcia, and Saal, 1996 and Caprio and Klingebiel, 1996). This led to the remarkable discovery that a full

three-quarters of the membership had experienced significant banking problems during 1980–96. These studies showed that the extent and nature of the problems varied substantially, including cases of insolvency of one or two large banks and situations in which loss-making government-owned institutions needed chronic recapitalisation. But weaknesses extended to all regions of the world and levels of development. Bank fragility was pervasive and multifaceted, a phenomenon ripe for more systematic empirical investigation.

The surveys provided the raw material to construct a sample, while economic theories and case studies suggested mechanisms and channels through which economic conditions and structural characteristics might impact bank stability. In the rest of the paper we will summarise the main methodological approaches, results, and open questions in cross-country studies of banking crises.

3. Two econometric approaches to identifying the determinants of banking crises

The signals approach

The signals approach, originally developed to identify turning points in business cycles, was first applied to banking crises by Kaminsky and Reinhart (1999). This study focuses on the phenomenon of the 'twin crises', namely the simultaneous occurrence of currency and banking crises. To this end, the paper documents the incidence of currency, banking, and twin crises in a sample of twenty industrial and emerging countries 1970–95. Currency crises are identified based on an index of market turbulence developed by Eichengreen *et al*. (1995), while the onset of a banking crises is assumed to coincide with depositor runs leading to the closure or takeover of one or more banks, or with large-scale government intervention to assist, take over, merge, or close one or more financial institutions, leading to more intervention elsewhere in the financial system.

Currency crises are found to be much more frequent than banking crises in the sample (76 episodes versus 26); of these, 19 episodes are twin crises, so a wide majority of banking crises is also accompanied by an exchange rate crash. However, because the sample was chosen to include only countries with fixed or heavily managed exchange rates for which currency crashes are more common, the sample selection criterion may overemphasise the importance of the exchange rate for banking crises.

The second step in Kaminsky and Reinhart's analysis is to describe the behaviour of fifteen macroeconomic variables in the 24 months preceding and following crises and compare it with the behaviour during tranquil times. Concerning banking crises, the main indications emerging from the data are that in the months preceding a crisis monetary growth and interest rates (both lending and deposit rates) are above normal, suggesting a high level of demand for money and credit. Among external balance indicators, export growth appears below trend before banking crises, and the real exchange rate is appreciating. Finally, real output growth falls below trend about eight months before the peak of the banking crisis, while stock prices peak at about the same time. This suggests that banking crises are preceded by a cyclical downturn.

The third part of Kaminsky and Reinhart's study is a more formal econometric investigation of the factors associated with the onset of crises using the signals approach. According to this methodology, the behaviour of each relevant variable during the 24 months prior to a crisis is contrasted with the behaviour during 'tranquil' times. A variable is deemed to signal a crisis any time it crosses a particular threshold. If the signal is followed by a crisis within the next 24 months it is considered correct; otherwise it is a false alarm. The threshold for each variable is chosen to minimise the in-sample noise-to-signal ratio.[3] Finally, the performance of each signal is compared based on three yardsticks: the associated type I and type II error (probability of missing a crisis and probability of a false signal, respectively),

the noise-to-signal ratio, and the probability of a crisis occurring conditional on a signal being issued.

Kaminsky and Reinhart (1999) find that for banking crises the indicator with the lowest noise-to-signal ratio and the highest probability of crisis conditional on the signal is the appreciation of the real exchange rate, followed by equity prices and the money multiplier. These three indicators, however, have a large incidence of type I error, as they fail to issue a signal in 73–79 per cent of the observations during the 24 months preceding a crisis. The incidence of type II error, on the other hand, is much lower, ranging between 8 and 9 per cent. The variable with the lowest type I error is the real interest rate, which signals in 30 per cent of the pre-crisis observations. Another interesting finding is that indicators reflecting developments in the real rather than the monetary sector seem to be more closely associated with banking crises rather than currency crises. In addition, twin crises are preceded by more acute 'warning signs' than individual crises and have more protracted adverse effects.

The multivariate logit approach

With the signals approach each possible covariate is considered in isolation, and the econometric model does not provide a way to aggregate the information provided by each indicator. What should be done if one indicator signals a crisis but another does not? Another difficulty is that, by focusing only on whether or not the variable in question has crossed the crucial threshold, the methodology ignores a lot of information in the data; whether an indicator is barely above the threshold rather than well above it is presumably important in assessing fragility, but the signals method does not make use of this information.

An alternative methodology to study the covariates of banking crisis, which remedies some of these problems, is the multivariate logit approach developed by Demirgüç-Kunt and Detragiache (1998). With this approach, the probability that a crisis occurs is assumed to be a function of a vector of explanatory variables. A logit econometric model is fitted to the data and an estimate of the crisis probability is obtained by maximising the likelihood function. Thus, the model produces a summary measure of fragility (the estimated probability of crisis) which makes the best possible use of the information in the explanatory variables (subject to the hypothesised functional form).

More formally, in each period the country is either experiencing a crisis or it is not. Accordingly, the dependent variable takes the value zero if there is no crisis and takes the value one if there is a crisis. The probability that a crisis will occur at a particular time in a particular country is hypothesised to be a function of a vector of *n* explanatory variables $X(i, t)$. Letting $P(i, t)$ denote the banking crisis dummy variable, denote a vector of *n* unknown coefficients, and denote the cumulative probability distribution function evaluated at , the log-likelihood function of the model is:

$$\text{Ln L} = \Sigma_{t=1..T} \Sigma_{i=1..n} \{P(i,t) \ln[F(\beta' X(i,t))] + (1-P(i,t)) \ln[1 - F(\beta' X(i,t))]\}.$$

The probability distribution F is assumed to be logistic. Thus, the estimated coefficients reflect the effect of a change in an explanatory variable on $\ln(P(i,t)/(1-P(i,t))$. Therefore, the increase in the probability depends upon the original probability, and thus upon the initial values of all the independent variables and their coefficients.

An important methodological issue is how to deal with observations following the onset of a banking crisis, when the behaviour of some of the explanatory variables is likely to be affected by the crisis itself. For instance, the real interest rate might fall due to the loosening of monetary policy that often accompanies banking sector rescue operations.

Clearly, this type of feed-back effect would muddle the relationships; to avoid this problem, years during which the crisis is unfolding are typically excluded from the sample.

Another key element of our study was the construction of the banking crisis dummy variable. Beginning from a sample of all the countries in the world, economies in transition were excluded based on the view that the problems in these countries were of a special nature. The following step was to identify all episodes of banking sector distress, drawing from the surveys of Caprio and Klingebiel (1996) and Lindgren *et al.* (1996) and from other case studies. To distinguish between fragility in general and crises in particular, and between localised crises and systemic crises, we established – somewhat arbitrarily – that for an episode of distress to be classified as a full-fledged crisis in our panel, at least one of the following four conditions had to hold: the ratio of non-performing assets to total assets in the banking system exceeded 10 per cent; the cost of the rescue operation was at least 2 per cent of GDP; banking sector problems had led to a large scale nationalisation of banks; extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalised deposit guarantees were enacted by the Government in response to the crisis.

Table 1 shows a version of the regressions in our 1998 paper, in which the sample has been extended through 2002 and to include more countries. The number of crises episodes in the baseline specification has risen from 31 to 77, a sizable improvement (table 2).[4] The findings are by and large consistent with those of the earlier paper, indicating that the relationships are fairly robust.

Low GDP growth, high real interest rates, and high inflation are significantly correlated with the occurrence of a banking crisis. Thus, crises tend to manifest themselves during periods of weak economic growth and loss of monetary control. Exposure to real interest rate risk is also a source of banking fragility. This is consistent with the view that

higher and more volatile real interest rates during the 1980s and 1990s, relative to the previous two decades, may have contributed to the greater incidence of banking crisis. Changes in the terms of trade and exchange rate depreciation are not significant. The fiscal variable (the budget surplus scaled by GDP) has a positive coefficient, but it is significant only when deposit insurance is omitted.[5]

Among the banking sector variables, the ratio of broad money to foreign exchange reserves, measuring vulnerability to a run on the currency, enters positively and significantly, suggesting that bank exposure to currency crises plays a role in banking crises. Credit to the private sector enters with a positive sign, indicating that countries where the banking sector has a larger exposure to private sector borrowers are more vulnerable, perhaps as a result of mismanaged liberalisation. Also consistent with this finding, high lagged credit growth, which may capture a credit boom, is significantly and positively correlated with the probability of a crisis in all specifications.

Concerning the institutional variables, the level of development as measured by GDP per capita is negatively correlated with systemic banking sector problems, indicating that developing countries are more vulnerable to bank fragility. In addition, the presence of an explicit deposit insurance scheme appears to be a risk factor, probably because the positive effect operating through a reduction in self-fulfilling panics is more than offset by the negative effect operating through moral hazard. We will return to deposit insurance in Section 5.

4. Using econometric models of banking crises as early warning systems[6]

As banking crises spread in the 1990s, the need to improve monitoring capabilities of financial vulnerabilities at both national and international levels became acute, and the search for useful 'early warnings' of banking crises intensified. Many authors identified variables

displaying anomalous behaviour before a crisis. For instance, Gavin and Hausman (1995) and Sachs, Tornell, and Velasco (1996) proposed using credit growth as a crisis indicator to detect credit booms. Mishkin (1996) highlighted equity price declines, while Calvo (1996) suggested monitoring the ratio of broad money to foreign exchange reserves, which had sharply increased before the Tequila crisis in Mexico.

In one of the first systematic evaluations of alternative indicators, Honohan (1997) uses a sample of eighteen crisis and six non-crisis countries and divides the former into three groups according to the type of crisis – macroeconomic, microeconomic, or related to the behaviour of the Government. He then compares the average values of seven indicators for crisis countries with the same averages for the control group. His results show that crises due to government intervention are associated with high levels of borrowing and central bank lending to the banking system. Further, banking crises stemming from macroeconomic problems are associated with high loan-to-deposit ratios, high foreign borrowing-to-deposit ratios, and high growth rates of credit. Interestingly, crises originating from microeconomic pressures are not associated with abnormal behaviour in any of the indicators.

Rojas-Suarez (1998) proposes an approach similar to the CAMEL early warning system used by US regulators to identify problem banks.[7] In emerging markets, particularly Latin America, she recommends also monitoring a number of non-CAMEL indicators, such as deposit interest rates, the spread between lending and deposit rates, the growth rate of credit, and the growth rate of interbank lending. Because bank level indicators are compared to banking system averages, however, this approach is better at identifying weak banks within a system rather than systemic crises. Also, since the approach requires detailed bank level information, it is difficult to utilise for a large number of countries.

The signals approach introduced by Kaminsky and Reinhart (1999) was later applied to crisis prediction and further refined in Kaminsky (1999) and Goldstein, Kaminsky and Reinhart (2000).[8] Since the likelihood of crisis is expected to be greater when several indicators signal simultaneously, Kaminsky (1999) develops a composite index, constructed as the number of indicators that cross the threshold at any given time. Alternatively, a weighted variant may be used, in which each indicator is weighted by its signal-to-noise ratio so that more informative indicators receive more weight. The best composite indicator outperforms the real exchange rate in predicting crises in the sample, but it is worse at predicting tranquil observations.

In Demirgüç-Kunt and Detragiache (2000), we show that crisis probabilities estimated through a multivariate logit framework result in lower in-sample type I and type II errors than the signals of Kaminsky and Reinhart (1999), and can thus provide a more accurate basis for an early warning system. To explore how the logit model can be used to monitor bank fragility, we construct out-of-sample forecasts of crisis probabilities using coefficients estimated from the multivariate logit model and forecasts of right- hand-side variables drawn from professional forecasters or international institutions.

How can these forecasted probabilities be used to make a quantitative assessment of fragility? We consider two frameworks. In the first, the monitor wants to know whether there is enough fragility to take action. The measure of fragility is the forecast probability of a crisis. Deciding when this probability is high enough to act involves trading-off the costs of taking action when there is no crisis against the costs of doing nothing when the trouble is real. The monitor can be thought of as choosing this threshold by minimising a loss function that reflects the likelihood of having to pay either type of cost, which is evaluated based on the in-sample probabilities of type I and type II errors. So the optimal trigger for action depends not only on the in-sample predictive power of the model, but also on the costs of

making a mistake. These costs, of course, vary across decisionmakers. In a second monitoring framework, the monitor is simply interested in rating the fragility of the banking system. Depending on the rating, different courses of action may follow. It is desirable for the ratings to have a clear interpretation in terms of probability of crisis, so that they can be compared. Both monitoring frameworks can be used as tools to economise on precautionary costs by pointing to cases of high fragility that warrant more in-depth monitoring.

Applying the monitoring frameworks to six crisis episodes (Jamaica, Indonesia, Korea, Malaysia, Philippines and Thailand) shows that, while both actual and forecasted data would have indicated high vulnerability in Jamaica, the picture would have been much rosier for the Asian countries (see table 3). Although signs of fragility were present in Thailand and the Philippines, the overall image for these countries was fairly reassuring, as expectations of continued strong economic growth and stable exchange rates offset the negative impact of relatively high real interest rates and strong past credit expansion.[9]

Econometric analysis of systemic banking crises is a relatively new field, and the development and evaluation of monitoring and forecasting tools based on this analysis are also at an early stage. So far, these tools have met with only limited success, as in-sample prediction accuracy cannot be replicated out-of-sample, a problem common to many areas of economics. One explanation may be that new crises are different from those experienced in the past, so that the coefficients derived from in-sample estimation are of limited use out of sample. Another problem may be that banking crises are rare events, so in-sample estimates are based on relatively few data points.

One way to improve monitoring capabilities is to develop alternative scenarios – with high and low forecasts for the explanatory variables – and to examine banking sector fragility in the context of such scenarios. Stress-testing exercises utilised in the Financial Sector Assessment Programs by the IMF and World Bank are a step in this direction. Another

strategy might be to explore how movements in high-frequency variables, such as spreads on the interbank market or on commercial paper issued by banks, stock market valuation of banks, and corporate vulnerability, move before the onset of crises. Significant data collection efforts are needed to make this type of exercise feasible for a large sample of countries, however.

5. Studies of the determinants of banking crises

Following the early studies by Kaminsky and Reinhart (1999) and Demirgüç-Kunt and Detragiache (1998), work on the determinants of bank fragility has proceeded on several fronts. Most of the studies use the multivariate limited dependent model, while the signals approach has remained more popular in applications aimed at constructing early warning systems. In this section we summarise some of this work, organising the material based on the category of explanatory variables investigated.

Individual bank measures of fragility and systemic crises

The literature on early warnings of individual bank failure is well established, with empirical studies dating back to the early 1970s. This literature uses bank balance sheet and market information to explain and forecast the failure of individual institutions.[10] A few studies have adapted this approach to study systemic banking crises. For instance, González-Hermosillo (1999) uses bank-specific as well as macroeconomic data to investigate episodes of banking distress in different regions of the US and in two countries, Mexico and Colombia. She finds that non-performing loans and capital asset ratios often deteriorate rapidly before bank failure. This study also explicitly investigates how individual bank failure can be affected by overall fragility in the banking sector, and finds little evidence of such contagion.

Bongini, Claessens and Ferri (1999) investigate the Asian crises by focusing mostly on individual institution data. Specifically, they analyse how CAMEL variables, bank size, and corporate connections, as well as country dummies, explain bank failures. They find that CAMEL variables do reasonably well in predicting distress, that big financial institutions are more likely to become distressed but less likely to be closed, and that connected institutions are more likely to experience trouble. They conclude that while exogenous shocks played a role in causing the systemic crisis in Asia, there were also significant prior weaknesses at the individual bank level that contributed to distress.

Financial liberalisation and crises

The view that financial liberalisation may lead to greater financial fragility has been often articulated (Caprio and Summers, 1993; Stiglitz, 1994; see also Allen, 2005, this volume). Financial liberalisation gives banks greater opportunities to take on risk. With limited liability and implicit and explicit guarantees, when bank capital and charter value erode, bankers do not bear much downside risk. Unless the country has well developed institutions and good prudential regulation and supervision to curb risk-taking, liberalisation may increase fragility beyond socially desirable limits.

Demirgüç-Kunt and Detragiache (1999) find that banking crises are indeed more likely to occur in countries that have liberalised their financial systems, even after controlling for other country characteristics. This effect, however, is mitigated by a strong institutional environment, especially respect for the rule of law, low corruption and good contract enforcement. These results are consistent with the view that if liberalisation is not accompanied by sufficient prudential regulation and supporting institutions to ensure effective supervision, it is likely to result in excessive risk-taking and a subsequent crisis. Later empirical studies by Mehrez and Kaufmann (1999), Glick and Hutchison (2001), Arteta

and Eichengreen (2002), and Noy (2004) similarly find that financial liberalisation can significantly increase bank fragility.

International shocks, exchange rate regime, and crises

Another line of research investigates the impact of worldwide economic shocks and the exchange rate regime on bank fragility. A number of observers noticed the relationship between financial difficulties in emerging markets and tighter monetary conditions and growth deceleration in the industrialised world.[11] For instance, the Volcker disinflation in the US in 1979–81 has been blamed for contributing to the financial crises in Latin America in the early 1980s. Similarly, the monetary tightening in the United States in 1994 may have contributed to the Mexican crisis.

Eichengreen and Rose (1998) is the first empirical paper on the role of international shocks in banking crises. It finds a strong effect of OECD interest rates and, to a smaller extent, OECD GDP growth, on bank fragility in developing countries. Arteta and Eichengreen (2002) find that when the sample is extended to include more recent years, the evidence of an OECD effect becomes weaker. These authors conclude that the banking crises of the mid-1990s were different from earlier episodes, with external factors playing a much smaller role compared to domestic factors.

The impact of external factors on bank fragility might vary with the exchange rate regime. For instance, flexible exchange rates may have a stabilising effect on the financial system since the exchange rate can absorb some of the real shocks to the economy (Mundell, 1961). Flexible regimes may also curtail the tendency of countries to over-borrow in foreign currency and discourage banks from funding dangerous lending booms through external credit (Eichengreen and Hausmann, 1999). Further, with a fixed exchange rate (and even more so with a currency board), lender of last resort operations are severely limited, as

domestic monetary expansion risks undermining confidence in the currency peg. Thus, a country with fixed exchange rate regime may be more prone to bank runs and financial panics (Eichengreen and Rose, 1998; Wood, 1999).

On the other hand, Eichengreen and Rose (1998) note that a commitment to a currency peg may reduce the probability of banking crises by disciplining policymakers. The lack of an effective lender of last resort may also discourage risk-taking by bankers, decreasing the likelihood of a banking crisis. Finally, developing countries are often plagued by lack of credibility and limited access to international markets, and suffer from more pronounced effects of exchange rate volatility due to their high liability dollarisation. Thus, the additional transparency and credibility associated with fixed exchange rates may insulate a country from contagion (Calvo, 1999).

Empirically, Arteta and Eichengreen (2002) find that countries with fixed and flexible exchange rates are equally susceptible to banking crises. In contrast, Domaç and Martinez-Peria (2003) find that adopting a fixed exchange rate diminishes the likelihood of a banking crisis in developing countries. In addition, once a crisis occurs, its economic cost is larger under a fixed exchange rate.

Studies on the impact of dollarisation on banking fragility similarly reveal mixed evidence. Arteta (2003) investigates the impact of deposit and credit dollarisation for a large number of developing and transition countries and finds no evidence that dollarisation increases fragility. De Nicolo, Honohan and Ize (2003) perform a similar test, but measure fragility using average Z-scores (measuring the distance to default for the banking system, which is different from the actual occurrence of a systemic crisis) and non-performing loans across a large number of countries. In contrast to Arteta's results, they find that dollarisation is positively related to both measures of bank fragility.

Bank ownership and structure and crises

The nature of bank ownership, whether private or public, domestic or foreign, has been found to have a strong association with various aspects of bank performance. Does the likelihood of a systemic banking crisis also depend on who owns the banks?

State ownership of banks, although declining, continues to be popular in many countries, despite widespread evidence of political abuse and governance problems in state-owned institutions (World Bank, 2001). La Porta, Lopez-de-Silanes and Shleifer (2002) and Barth, Caprio and Levine (2001) find that greater state ownership in banking is associated with reduced competition, poorer productivity and lower growth. Concerning systemic crises, Caprio and Martinez-Peria (2000) show that greater state ownership at the beginning of the 1980s is associated with a greater probability of a banking crisis during 1980–97. Using simple cross-sectional regressions, Barth, Caprio and Levine (2001) confirm this finding.

Whether developing countries should welcome foreign ownership of banks is also a highly disputed issue, particularly as the share of banking assets controlled by foreign banks soared in Africa, Latin America, and Eastern Europe in recent years (World Bank, 2001). Empirical studies have shown that by improving overall operating efficiency, foreign entry helps create the conditions for improved financial intermediation and long-term growth (Claessens, Demirgüç-Kunt and Huizinga, 2001).

On systemic fragility, one concern is that foreign banks may not have a lower long-term commitment to the host country and might flee at the first signs of trouble. Even worse, they may introduce a new source of contagion by withdrawing from the host country when conditions in their home country deteriorate. Existing empirical evidence does not support these concerns. Demirgüç-Kunt, Levine, and Min (1998) find that the presence of foreign banks is associated with a lower risk of banking crisis. Dages *et al*. (2000) find that foreign banks operating in Argentina and Mexico had stronger and less volatile loan growth than

domestic banks during and after the Tequila Crisis (1994–9). Peek and Rosengren (2000) reach a similar conclusion for both direct (or cross-border) lending and local lending by foreign banks in Argentina, Brazil, and Mexico from 1994 to 1999. In Malaysia, Detragiache and Gupta (2004) show that foreign banks performed better during the crisis, but only those from outside the region, while foreign banks with an Asian focus did not perform significantly better than domestic banks.

Another reason for concern related to foreign entry is its impact on fragility via competition. Foreign entry might increase competition, which will likely improve bank efficiency, but more competition may destabilise the banking system. Beck, Demirgüç-Kunt and Levine (2004) study the impact of bank concentration, bank regulations, and national institutions on the likelihood of experiencing a systemic banking crisis. They find that banking crises are less likely in economies with more concentrated banking systems, fewer regulatory restrictions on bank competition and activities, and national institutions that encourage competition. Thus, there is no evidence that greater competition is damaging to stability.[12] While concentration is also associated with lower bank fragility, this result likely reflects better risk diversification by larger banks in more concentrated systems rather than less competition.

The role of institutions

The role of institutions in affecting bank fragility has been investigated extensively. In Demirgüç-Kunt and Detragiache (1998), we proxy institutional development by GDP per capita and an index of law and order, and show that weaker institutional environments are related to higher probability of banking crises. Mehrez and Kaufmann (1999) consider the effects of transparency on banking crises in financially liberalised markets. They find that

countries with low transparency (or high corruption) are more likely to experience banking crises as a result of financial liberalisation.

Another important characteristic of the institutional environment is the presence of an explicit deposit insurance scheme. While explicit deposit insurance should reduce bank fragility by eliminating the possibility of self-fulfilling panics, it is also well-known that it may create incentives for excessive risk-taking (Kane, 1989). In Demirgüç-Kunt and Detragiache (2002), we find that explicit deposit insurance is associated with a higher probability of banking crisis in a large sample of countries, the more so if bank interest rates are deregulated and if the institutional environment is weak. These results support the arguments that moral hazard is a greater problem in liberalised financial systems where greater risk-taking opportunities are available, and in countries with weaker institutions, where it is more difficult to monitor and curb the excess risk-taking by banks. Furthermore, the impact of deposit insurance on bank fragility varies with design of the system, i.e., it is possible to curb moral hazard with better design. Features such as lower coverage, co-insurance, private sector involvement in the management of the scheme, ex-post funding, and mandatory membership are associated with lower levels of bank fragility.

Other studies explore this issue further. Arteta and Eichengreen (2002) find these results to be less robust, but they look at a sub-sample including only developing countries and ignore differences in deposit insurance design. Cull, Senbet and Sorge (2005) investigate how the decision to introduce deposit insurance affects the volatility of financial development indicators, such as credit to the private sector as a share of GDP and the ratio of M3 to GDP. They find that explicit deposit insurance increases volatility in countries with weak institutional development. In a related paper, Demirgüç-Kunt and Huizinga (2004) use bank-level data to study how deposit insurance affects market discipline of banks. Focusing on the disciplinary role of interest rates and deposit growth, they find that market discipline is

stronger in countries with better institutions, but generously designed deposit insurance can still curtail it, resulting in fragility.

The issue of how bank regulation and supervision affects banking crises is very important, since ensuring bank safety and soundness is a major goal of bank regulators. Barth, Caprio and Levine (2004), having developed a comprehensive survey database on measures of regulation and supervision, are able to investigate this issue empirically for the first time. Their results indicate that regulatory and supervisory practices that force accurate information disclosure, empower private sector monitoring of banks, and foster incentives for private agents to exert corporate control work best to promote bank performance and stability. In a cross-country setting they show that regulatory and supervisory regimes with these features have suffered fewer crises in the past two decades. Barth, Caprio and Levine (2004) also confirm that poorly designed explicit deposit insurance leads to greater probability of banking crises, even after controlling for regulation and supervision.[13]

The political system and crises

Political considerations may play a very important role in government decisions to deal with insolvent institutions. Based on a rigorous examination of the US Savings and Loan crisis, Kroszner (1997) argues that disseminating information about the costs of inefficient government policy, ensuring competition among interest groups, increasing the transparency of government decisions, improving the structure of legislative oversight of the regulatory process, and allowing entry of foreign banks are all measures that can potentially improve government financial sector policy and reduce the cost of crises. These recommendations place great importance on the disciplining role of information and the existence of competitive elections.

Brown and Dinc (2004) use data on individual bank failures in developing countries to investigate the impact of political factors on bank fragility. They find that political concerns play a significant role in delaying government intervention in failing banks. For instance, failing banks are less likely to be taken over by the Government or lose their licenses before elections than after elections. This effect becomes even stronger when the ruling party is politically weak.

This brief summary of the recent additions to the bank crisis literature reveals that there has been significant interest in how institutions – economic, financial or political – affect bank fragility. Another broad area of focus has been the impact of the policy framework – financial liberalisation, exchange rate regime, policy on foreign bank entry – on bank stability. Most of the research on these themes uses the multivariate probability model and low frequency data, since institutional and structural variables change slowly over time. Because of this literature, we now know much more and will no doubt continue to learn more about the fundamental reasons underlying financial crises. But what are the economic consequences of banking crises? We turn to this question next.

6. The effects of banking crises

The credit crunch hypothesis

A number of empirical studies of banking crises examine not only what causes crises but also how crises affect the rest of the economy. For example, summarising several case studies, Lindgren, Garcia, and Saal (1996) conclude that bank fragility has adversely affected economic growth. More systematic empirical investigations have also shown that output growth and private credit growth drop significantly below normal in the years around banking crises (Kaminsky and Reinhart, 1999; Eichengreen and Rose, 1998; Demirgüç-Kunt *et al*., *forthcoming*).

Measures of output loss relative to trend during financial crises have been used to compare the severity of these events. For instance, Bordo *et al.* (2001) show that financial crises (currency crises, banking crises, or both) entailed similar-sized output losses in recent years as compared to previous historical periods. Crises, however, are more frequent now than during the Gold Standard and Bretton Woods periods, and are as frequent now as in the interwar years. Hoggarth *et al.* (2002) make the point that output losses associated with banking crises are not more severe in developing countries than in developed countries.

An obvious question raised by these studies is whether causality goes from output losses to banking crises or the other way around. The answer has obvious policy implications: if crises indeed have real costs, then the case for generous bank rescue operations is strengthened, even though these policies have large fiscal costs and adverse incentive effects *ex ante*. Conversely, if the output slowdown is mainly the result of exogenous shocks, then bailouts might not be beneficial. Sorting out causality, however, is a challenging task.

As the literature surveyed in the preceding section shows, crises are accompanied by worsening macroeconomic performance triggered by adverse shocks, such as a tightening of monetary policy, the end of a credit boom, or a sudden stop in foreign capital inflows. A distressed banking sector, in turn, may be a serious obstacle to economic activity and aggravate the effect of adverse shocks. For instance, when banks are distressed, firms may be unable to obtain credit to deal with a period of low internal cash flow. In fact, lack of credit may force viable firms into bankruptcy. Similarly, lack of consumer credit may worsen declines in consumption and aggregate demand during a recession, aggravating unemployment. In extreme cases, bank runs and bank failures can threaten the soundness of

the payment system, making transactions more difficult and expensive. These mechanisms suggest that fragile banks hinder economic activity (the credit crunch hypothesis).

On the other hand, there are several channels through which exogenous adverse shocks to the economy might cause a decline in credit and economic activity even if the banking sector itself is relatively healthy. For instance, adverse shocks may trigger a fall in aggregate demand, leading firms to cut production and investment and, consequently, credit demand. Increased uncertainty may also cause firms to delay investment and borrowing decisions. Finally, adverse shocks might worsen agency problems and complicate lending relationships, for instance by reducing the net worth of borrowers. This, in turn, might cause banks to abandon high risk borrowers (flight to quality) or raise lending spreads. So output and bank credit may decelerate around banking crises even if there is no feedback effect from bank distress to credit availability.[14]

Existing studies of individual country experiences have found conflicting evidence on the relationship between bank distress and real activity. In a study of the so-called capital crunch in the United States in 1990, Bernanke *et al*. (1991) argue that a shortage of bank capital had little to do with the recession. Domaç and Ferri (1999) reached the opposite conclusion for Malaysia and Korea during 1997–8. They found small and medium-sized firms to have suffered more than large firms during the crisis. Since these firms are usually more dependent on bank credit than large firms, this is evidence of a credit crunch. Data from a survey of Thai firms, on the other hand, suggest that poor demand rather than lack of credit caused the decline in production, although many firms complained about high interest rates (Dollar and Hallward-Driemeier, 2000). For Indonesia and Korea, Ghosh and Ghosh (1999) test an aggregate model of credit demand and supply and find evidence of a credit crunch, but only in the first few months of the crisis. Finally, using firm level data from Korea, Borensztein and Lee (2002) show that firms belonging to industrial groups (*chaebols*) lost

their preferential access to credit during the banking crisis, although this was not necessarily evidence of a credit crunch.

New evidence on the credit crunch hypothesis comes from a recent study by Dell'Ariccia *et al*. (2005). To identify the real effects of banking crises, this paper follows the 'difference-in-difference' approach adopted by Rajan and Zingales (1998) to study the effects of finance on growth. Using a panel of countries and industry-level data, the authors test whether more financially dependent sectors perform significantly worse during banking crises, after controlling for all possible time-specific, country-specific, and industry-specific shocks that may affect firm performance. The main result is that indeed more financially dependent sectors suffer more during crises, evidence in favor of the credit crunch hypothesis. The results are robust to controlling for other possible explanations, such as flight-to-quality during recessions, the effects of concomitant currency crises, and the exposure of bank portfolios to specific bank-dependent industries. Furthermore, the magnitude of the effect is non-trivial: more financially dependent sectors lose about 1 percentage point of growth in each crisis year compared to less financially dependent sectors. Finally, consistent with the theory, the differential effects are stronger in developing countries, in countries where the private sector has less access to foreign finance, and where the crises are more severe.

Intervention policies and the costs of crises

A few studies have used cross-country empirical analysis to study which intervention policies can minimise the costs of a banking crisis. This question is as important to policymakers as it is difficult to answer through empirical analysis. One problem is that compiling accurate information on intervention policies for a large enough sample of crises is a laborious task. Another difficulty is that the sequence, timing, and specific modalities of a bank support

strategy are crucial to the outcome, and it is difficult to capture these complex dimensions through quantitative measures of policies.

Honohan and Klingebiel (2003) construct a database with estimates of the fiscal cost of 40 banking crises and catalogue the policies adopted in each episode, classified according to five broad categories: blanket guarantees to depositors, liquidity support to banks, bank recapitalisation, financial assistance to debtors, and forbearance. With this database, the authors explore how the different intervention policies affect the fiscal cost of the bailout, after controlling for country and crisis characteristics. They conclude that more generous bailouts resulted in higher fiscal costs.

Further evidence on the determinants of the fiscal costs of crises is provided by Keefer (2001), who focuses on the political economy of crises resolution. He finds that when voters are better informed, elections are close, and the number of veto players is large, governments make smaller fiscal transfers to the financial sector and are less likely to exercise forbearance in dealing with insolvent financial institutions. Thus, transparency, information dissemination, and competition among interest groups play an important role is shaping crisis response policies.

The relationship between intervention policies and the economic – rather than fiscal – costs of crises is explored by Claessens, Klingebiel, and Laeven (2003). Costs are measured by the output loss relative to trend during the crisis episode. The main finding is that generous support to the banking system does not reduce the output cost of banking crises. However, since omitted exogenous shocks may simultaneously cause a stronger output decline and more generous intervention measures, the interpretation of the results is ambiguous. Nevertheless, the results survive even after the authors control for a large set of variables such as GDP growth prior to crisis, existence of deposit insurance, inflation rate at the onset of the crisis, state ownership of banks, degree of dollarisation and others.

7. Conclusions

Cross-country econometric research on systemic banking crises has progressed rapidly in recent years. As a result, we have a better understanding of how systemic bank fragility is influenced by a host of factors, ranging from macroeconomic shocks, the structure of the banking market, broad institutions, institutions specific to credit markets, and political economy variables. Because (fortunately!) banking crises are rare events, existing studies are based on a relatively small number of episodes. Going forward, as broader samples become available, it will be important to continue to assess the robustness of the conclusions reached to date.

To improve model performance it may also be useful to perfect the definition of a banking crisis. Some crises are the result of long-simmering problems being brought into the open, while others are sudden events, triggered by severe exogenous shocks. While the two phenomena are certainly related, because they both are rooted in underlying institutional weaknesses and may have similar manifestations, distinguishing between these two types of crises may help identify clearer and more robust relationships, especially with macroeconomic variables.

As is often the case in economics, empirical models have been more useful in identifying factors associated with the occurrence of banking crises than at predicting the occurrence of crises out of sample. In part, this reflects the fact that, for the most part, the empirical models were not conceived as forecasting tools. Developing useful early warning indicators of impeding bank vulnerability will doubtless remain a priority for policymakers, and more specific research in this direction would be useful. Work with annual data suggests that macroeconomic correlates of crises tend to lose significance if they are lagged by one year. This likely indicates that the time it takes for adverse economic shocks to be transmitted

to the banking system is quite short. Consequently, the search for useful early warning indicators should move towards high frequency data, such as market data. To explore how market data performs in crisis prediction, however, requires more work to define and date crisis episodes accurately. Future research should proceed in this direction.

The question of how institutional variables, such as politics and regulation, influence bank fragility has been a fruitful area of exploration, and there are several directions in which this work can continue. For example, it would be interesting to study how compliance with banking regulation and the introduction of the BASEL II capital agreement might affect financial stability, particularly in developing countries (see also Goodhart, 2005, this volume). Another area of focus has been the impact of policy choices such as liberalisation, foreign bank entry, and the resulting market structures on bank fragility. As banking systems around the world are being quickly reshaped by globalisation and consolidation, the study of how these trends affect bank fragility will continue to attract attention.

Finally, the field of banking crises is at the crossroads of open economy macroeconomics and the microeconomics of banking and regulation. These two areas of research have evolved quite separately in the past, but to understand financial crises insights from both fields must be brought together. Exploring more closely how bank level information can be incorporated in cross-country empirical models of banking crises would be a useful direction for future research.

NOTES

1 Among studies of banks and credit during the Great Depression, see for instance Bernanke (1983), Haubrich (1990), and Calomiris and Mason (1997). Gorton (1988) uses a sample of banking crises from the US National Banking Era (1863-1914) to test whether panics were caused by depositors' reaction to a forthcoming economic downturn or by self-fulfilling beliefs.

2 Some examples of case studies include Garcia-Herrero (1997), Drees and Pazarbasioglu (1998), Jaramillo (2000), Gonzáles-Hermosillo et al. (1997), Ramos (1998), and Schumacher (2000). Among papers drawing general lessons, see Davis (1995), Gavin and Hausman (1995), Goldstein and Turner (1996), Mishkin (1996), Rojas-Suarez and Weisbrod (1995), and Sheng (1995).

3 The authors use an 'adjusted' version of the noise-to-signal ratio, computed as the ratio of the probability of false alarms (type II error) to one minus the probability of a missing a crisis (type I error).

4 As in Demirgüç-Kunt and Detragiache (1998), we estimate the model without country fixed effects because we want to include non-crisis countries as controls. In the new regressions, however, we allow for the error terms to be correlated within each country by clustering the errors by country. In the 1998 paper we just used robust standard errors.

5 Also, including the fiscal deficit in the regressions markedly reduces the number of observations.

6 See also Bell and Pain (2000) for a recent review of leading indicator models of banking crisis.

7 CAMEL stands for Capital Adequacy, Asset Quality, Management, Earnings and Liquidity.

8 Borio and Lowe (2002 and 2005, this volume) also present a model based on the signals approach. In a related paper, Boyd, Gomis, Kwak and Smith (2000) focus on the cost of crisis and present a detailed review of macro conditions before, during and after crises, for more than 50 crisis countries, basing their discussion on a general equilibrium model. They highlight the great diversity of economic conditions that precede crises, drawing the conclusion that it is difficult to rule out sunspots, i.e. random events, as the cause of many crises.

9 Using a variant of the multivariate logit model, in which the crisis dummy takes the value of one in the year before the crisis and the value of two in the year of the crisis, Hardy and Pazarbasioglu (1999) also find that macroeconomic indicators were of limited value in predicting the Asian crises. In none of these countries was the pre-crisis period identified as problematic. They conclude that the best warning signs for these crises were proxies for the vulnerability of the banking and corporate sector.

10 See Demirgüç-Kunt (1989) for a review of this early literature.

11 See Eichengreen and Fishlow (1998) for a review of this literature.

12 This study does not address the question of whether foreign entry leads to a less concentrated banking system, however.

13 It is not possible to control for the quality of regulation and supervision in a panel of data, such as is typically used on banking crisis regressions, because measures of these dimensions are only available after 1999. Results from cross-sectional tests show that countries with more generous deposit insurance design are likely to have experienced crises since the 1980s, even after controlling for supervision and regulation.

14 An additional problem is that changes in the aggregate stock of real credit to the private sector are not a good measure of the flow of credit available to the economy, especially around banking crises, because of valuation effects caused by inflation or exchange rate changes. Also, a decline in the stock of credit may result from restructuring operations that transfer non-performing loans to agencies outside the banking system (Demirgüç-Kunt, *et al.*, forthcoming).

REFERENCES

Arteta, C. (2003), 'Are financially dollarized countries more prone to costly crises?', International Finance Discussion Paper, Board of the Governors of the Federal Reserve System, No. 763.

Arteta, C. and Eichengreen, B. (2002), 'Banking crises in emerging markets: presumptions and evidence', in Blejer, M. and Skreb, M.(eds), *Financial Policies in Emerging Markets*, Cambridge, MA, MIT Press.

Akerlof, G.P. and Romer, P. (1993), 'Looting: the economic underworld of bankruptcy for profit', *Brookings Papers on Economic Activity*, pp.1–73.

Barth, J., Caprio, G. and Levine, R. (2001), 'Banking systems around the globe: do regulations and ownership affect performance and stability?', in Mishkin, R. (ed.), *Prudential Supervision: What Works and What Doesn't*, University of Chicago Press.

—(2004), 'Bank regulation and supervision: what works best?', *Journal of Financial Intermediation*.

Beck, T., Demirgüç-Kunt, A. and Levine, R. (2004), 'Bank regulation, concentration and crises', World Bank mimeo.

Bell, J. and Pain, D. (2000), 'Leading indicator models of banking crises – a critical review', *Financial Stability Review*, Bank of England, issue 9, article 3, pp. 113–29.

Bernanke, B.S. (1983), 'Nonmonetary effects of the financial crisis in the propagation of the Great Depression', *American Economic Review*, 73, pp. 257–76.

Bernanke, B.S., Lown, C.S. and Friedman, B.M. (1991), 'The credit crunch', *Brookings Papers on Economic Activity* (2), pp. 205–39.

Bongini, P., Claessens, S. and Ferri, G. (1999), 'The political economy of distress in East Asian financial institutions', World Bank mimeo.

Borio, C. and Lowe, P. (2002), 'Assessing the risk of banking crises', *BIS Quarterly Review*, pp. 43–54.

Bordo, M., Eichengreen, B., Klingebiel, D. and Martinez-Peria, M.S. (2001), 'Is the crisis problem growing more severe?', *Economic Policy*, 32, pp. 51–82.

Borensztein, E. and Lee, J.-W. (2002), 'Financial crisis and credit crunch in Korea: evidence from firm-level data', *Journal of Monetary Economics*, 49, pp. 853–75.

Boyd, J., Gomis, P., Kwak, S. and Smith B. (2000), 'A user's guide to banking crises', University of Minnesota mimeo.

Brown, C.O. and Dinc, S. (2004), 'The politics of bank failures: evidence from emerging markets', University of Michigan Business School.

Calomiris, C. and Mason, J.R. (1997), 'Contagion and bank failures during the Great Depression: the Chicago 1932 bank panic', *American Economic Review*, 87, 5, pp. 883–63.

Calvo, G. (1996), 'Capital flows and macroeconomic management: Tequila lessons', *International Journal of Finance and Economics*, 1, 3, pp. 207–24.

—(1999), 'Testimony on full dollarization', presented before a joint hearing of the subcommittees on Economic Policy and International Trade and Finance, US Congress, April.

Caprio, G. and Klingebiel, D. (1996), 'Dealing with bank insolvencies: cross country experience', Policy Research Working Paper no. 1620, The World Bank, Washington, DC.

Caprio, G. and Martinez-Peria, M.S. (2000), 'Avoiding disaster: policies to reduce the risk of banking crises', Discussion Paper, Egyptian Center for Economic Studies, Cairo, Egypt.

Caprio, G. and Summers, L. (1993), 'Finance and its reform: beyond laissez-faire', Policy Research Working Paper no. 1171, The World Bank, Washington, DC.

Claessens, S., Demirgüç-Kunt, A. and Huizinga, H. (2001), 'How does foreign entry affect domestic banking markets?', *Journal of Banking and Finance*, 25, 5, pp. 891–911.

Claessens, S., Klingebiel, S. and Laeven, L. (2003), 'Resolving systemic crises: policies and institutions', unpublished manuscript, The World Bank.

Cull, R., Senbet, L. and Sorge, M. (2005), 'Deposit insurance and financial development', *Journal of Money, Credit and Banking* (*forthcoming*).

Dages, G.B., Goldberg, L. and Kinney, D. (2000), 'Foreign and domestic bank participation in emerging markets: lessons from Mexico and Argentina', *Federal Reserve Bank of New York Economic Policy Review*, 6, 3, pp. 17–36.

Davis, E.P. (1995), *Debt, Financial Fragility, and Systemic Risk*, Oxford and New York, Oxford University Press.

Dell'Ariccia, G., Detragiache, E. and Rajan, R. (2005), 'The real effect of banking crises', IMF Working Paper No. 05/??.

Demirgüç-Kunt, A. (1989), 'Deposit-institution failures: a review of empirical literature', *Economic Review*, Federal Reserve Bank of Cleveland, 25, 4.

Demirgüç-Kunt, A. and Detragiache, E. (1998), 'The determinants of banking crises: evidence from developing and developed countries', IMF Staff Papers, 45, pp. 81–109.

Demirgüç-Kunt, A. and Detragiache, E. (1999), "Financial Liberalization and Financial Fragility," in Pleskovic B. and J. Stiglitz ed., Proceedings of the World Bank Annual Conference on Development Economics.

—(2000), 'Monitoring banking sector fragility: a multivariate logit approach', *World Bank Economic Review*, 14, 2, pp. 287–307.

—(2002), 'Does deposit insurance increase banking system stability? An empirical investigation', *Journal of Monetary Economics*, 49, pp. 1373–406.

Demirgüç-Kunt, A., Detragiache, E. and Gupta, P. (*forthcoming*), 'Inside the crisis: an empirical analysis of banking systems in distress', *Journal of International Economics and Finance*.

Demirgüç-Kunt, A. and Huizinga, H. (2004), 'Market discipline and deposit insurance', *Journal of Monetary Economics*, 51, 2.

Demirgüç-Kunt, A., Levine, R. and Min, H.-G. (1998), 'Opening to foreign banks: issues of stability, efficiency and growth', in Meltzer, A. (ed.), *The Implications of Globalization of World Financial Markets*, Seoul, Bank of Korea.

De Nicolo, G., Honohan, P. and Ize, A. (2003), 'Dollarization of the banking system: good or bad?', World Bank Policy Research Working Paper No. 3116.

Dell'Ariccia, G., Detragiache, E. and Rajan, R. (2005), 'The real effect of banking crises', unpublished, IMF.

Detragiache, E. and Gupta, P. (2004), 'Foreign banks in emerging market crises: evidence from Malaysia', IMF Working Paper No. 129.

Diaz-Alejandro, C. (1985), 'Good-bye financial repression, hello financial crash', *Journal of Development Economics*, 19, pp.1–24.

Dollar, D. and Hallward-Driemeier, M. (2000), 'Crisis, adjustment, and reform in Thai industrial firms', *The World Bank Research Observer*, 15, pp.1–22.

Domaç, I. and Ferri, G. (1999), 'The credit crunch in East Asia: evidence from field findings on bank behavior and policy issues', mimeo, The World Bank.

Domac, I. and Martinez Peria, M.S. (2003), 'Banking crises and exchange rate regimes: is there a link?', *Journal of International Economics*, 61, 1, pp 41–72.

Drees, B. and Pazarbasioglu, C. (1998), 'The Nordic banking crises: pitfalls in financial liberalization?', IMF Working Paper No. 161, Washington, DC, April.

Edwards, S. and Végh, C. (1997), 'Banks and macroeconomic disturbances under predetermined exchange rates, *Journal of Monetary Economics*, 40, 2, pp. 239–78.

Eichengreen, B. and Fishlow, A. (1998), 'Contending with capital flows: what is different about the 1990s?', in Kahler, M. (ed.), *Capital Flows and Financial Crises*, Ithaca, Cornell University Press, pp. 23–68.

Eichengreen, B. and Hausmann, R. (1999), 'Exchange rates and financial fragility', National Bureau of Economic Research, Working Paper no. 7418.

Eichengreen, B. and Rose, A. (1998), 'Staying afloat when the wind shifts: external factors and emerging-market banking crises', NBER Working paper no. 6370, January.

Eichengreen, B., Rose, A. and Wyplosz, C. (1995), 'Exchange market mayhem: the antecedents and aftermath of speculative attacks', Berkeley, University of California.

Garcia-Herrero, A. (1997), 'Banking crisis in Latin America in the 1990s: lessons from Argentina, Paraguay, and Venezuela', IMF Working Paper 97/40.

Gavin, M. and Hausman, R. (1995), 'The roots of banking crises: the macroeconomic context', in Hausman, R. and Rojas-Suarez, L. (eds), *Banking Crises in Latin America*, John Hopkins University Press, Baltimore.

Ghosh, S. and Ghosh, A. (1999), 'East Asia in the aftermath: was there a crunch?', IMF Working Paper No. 99/38.

Glick, R. and Hutchison, M. (2001), 'Banking and currency crises: how common are the twins?', in Glick, R. Moreno, R. and Spiegel, M (eds), *Financial Crises in Emerging Markets*, Cambridge, Cambridge University Press.

Goldstein, M., Kaminsky, G. and Reinhart, C. (2000), 'Assessing financial vulnerability. An early warning system for emerging markets', Institute for International Economics, Washington, DC.

Goldstein, M. and Turner, P. (1996), 'Banking crises in emerging economies: origins and policy options', BIS Economic Papers No. 46, October.

Gonzáles-Hermosillo, B. (1999), 'Determinants of ex ante Nanking System distress: a macro-micro empirical exploration of some recent episodes', IMF Working Paper, 99/33.

Gonzáles-Hermosillo, B., Pazarbasioglu, C. and Billings, R. (1997), 'Determinants of banking sector fragility: a case study of Mexico', IMF Staff Papers, September.

Gorton, G. (1988), 'Banking panics and business cycles', *Oxford Economic Papers*, 40, pp. 751–81.

Hardy, D. and Pazarbasioglu, C. (1999), 'Determinants and leading indicators of banking crises: further evidence', IMF Staff Papers, 46, 3, pp. 247–58.

Haubrich, J.G. (1990), 'Nonmonetary effects of financial crises: lessons from the Great Depression', *Journal of Monetary Economics*, 25, 2, pp. 223–52.

Hoggarth, G., Reis, R. and Saporta, V. (2002), 'Output costs of banking system instability: some empirical evidence', *Journal of Banking and Finance*, 26, pp. 825–55.

Honohan, P. (1997), 'Banking system failures in developing and transition countries: diagnosis and prediction', BIS Working Paper 39.

Honohan, P. and Klingebiel, D. (2003), 'The fiscal cost implications of an accommodating approach to banking crises', *Journal of Banking and Finance*, 27, pp. 1539–60.

Hoshi, T. and Kashyap, A.K. (2004), 'Japan's financial crisis and economic stagnation', *Journal of Economic Perspectives*, 18, 1, pp. 3–26.

Jaramillo, J.C. (2000), 'An overview of Paraguay's banking crisis during the 1990s', mimeo, International Monetary Fund.

Kane, E. (1989), *The S&L Insurance Mess: How Did it Happen?*, Urban Institute Press, Washington, DC.

Kaminsky, G. (1999), 'Currency and banking crises: the early warnings of distress', IMF working paper, No. 99/178.

Kaminsky, G. and Reinhart, C.M. (1999), 'The twin crises: the causes of banking and balance of payments problems', *American Economic Review*, 89, pp. 473–500.

Keefer, P. (2001), 'When do special interests run rampant? Disentangling the role of elections, incomplete information, and checks and balances in banking crises', World Bank.

Krozner, R.S. (1997), 'The political economy of banking and financial regulation in the US', in Furstenberg, G.M. von (ed.), *The Banking and Financial Structure in the NAFTA Countries and Chile*, Boston, Kluwer Academic Publishers.

La Porta, R., Lopez-de-Silanes, F. and Shleifer, A. (2002), 'Government ownership of banks', *Journal of Finance*, 57, pp. 265–301.

Lindgren, C.-J., Baliño, T.J.T., Enoch, C., Gulde, A.-M., Quintyn, M. and Teo, L. (1999), 'Financial sector crisis and restructuring. Lessons from Asia', IMF Occasional Paper No. 188.

Lindgren, C.J., Garcia, G. and Saal, M. (1996), *Bank Soundness and Macroeconomic Policy*, IMF, Washington DC.

Mehrez, G. and Kaufmann, D. (1999), 'Transparency, liberalization, and financial crises', World Bank.

Mishkin, F. S. (1996), 'Understanding financial crises: a developing country perspective', NBER Working Paper no. 5600, Cambridge MA.

Mundell, R. (1961), 'A theory of optimum currency areas', *American Economic Review*, 51, pp. 717–25.

Noy, I. (2004), 'Financial liberalization, prudential supervision, and the onset of banking crises', *Emerging Markets Review*, 5, pp. 341–59.

Peek, J. and Rosengren, E.S. (2000), 'Implications of the globalization of the banking sector: the Latin American experience', *Federal Reserve Bank of Boston New England Economic Review*, September–October, pp. 45–62.

Rajan, R. and Zingales, L. (1998), 'Financial dependence and growth', *American Economic Review*, 88, 3, pp. 393–410.

Ramos, A. (1998), 'Capital structures and portfolio composition during banking crisis – lessons from Argentina 1995', IMF Working Paper 98/121.

Rojas-Suarez, L. (1998), 'Early warning indicators of banking crisis: what works for developing countries?', Research department, Inter-American Development Bank, Washington, DC.

Rojas-Suarez, L. and Weisbrod, S. (1995), *Financial Fragilities in Latin America*, IMF Occasional Paper No. 132.

Sachs, J., Tornell, A. and Velasco, A. (1996), 'Financial crises in emerging markets: the lessons from 1995', *Brookings Papers on Economic Activity* 1(1996), pp. 147–98.

Schumacher, L. (2000), 'Bank runs and currency runs in a system without a safety net', *Journal of Monetary Economics*, 46, 1, pp. 257–77.

Sheng, A. (1995), *Bank restructuring*, Washington DC, The World Bank.

Stiglitz, J.E. (1994), 'The role of state in financial markets', in Bruno, M. and Pleskovic, B. (eds), *Proceedings of the World Bank Annual Conference on Development Economics*, Washington DC, World Bank.

Wood, G. (1999), 'Great crashes in history: have they lessons for today?', *Oxford Review of Economic Policy*, 15, pp. 98–109.

World Bank (2001), 'Finance for growth: policy choices in a volatile world', Policy Research Report, Washington DC.

Table 1. Banking Crisis Determinants

Multivariate Logit regressions of crisis regressions are estimated updating the analysis in Demirguc-Kunt and Detragiache (1998). In estimation, errors are clustered by country. The period covered is 1980-2002, with 94 countries and up to 77 crisis occurrences in the sample. The dependent variable takes the value one for the first year of the crisis and zero otherwise. Observations for periods during which the crisis is taking place are excluded from the sample. For the crisis episodes for which the crisis duration is unknown, three years after the crisis are dropped from the sample. Variable definitions and sources are given in the Appendix.

	(1)	(2)	(3)	(4)	(5)
GROWTH	-0.0967***	-0.0991***	-0.1115***	-0.1175***	-0.1035***
	(0.0259)	(0.0265)	(0.0319)	(0.0332)	(0.0274)
TOTCHANGE	0.0005	0.0006	-0.0024	-0.0028	0.0004
	(0.0061)	(0.0064)	(0.0066)	(0.0067)	(0.0065)
DEPRECIATION	-0.0675	0.0713	-0.1037	-0.1233	0.0490
	(0.3892)	(0.3830)	(0.3918)	(0.3946)	(0.3811)
RLINTEREST	0.0006***	0.0005***	0.0005***	0.0006***	0.0005***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
INFLATION	0.0007**	0.0006**	0.0007**	0.0007***	0.0006**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
RGDP/CAP	-0.0367**	-0.0359**	-0.0414**	-0.0544***	-0.0478***
	(0.0156)	(0.0168)	(0.0175)	(0.0184)	(0.0178)
FISCAL BALANCE/GDP			0.0033**	0.0014	
			(0.0016)	(0.0020)	
M2/RESERVES		0.0012*	0.0062***	0.0066***	0.0013*
		(0.0007)	(0.0021)	(0.0022)	(0.0007)
PRIVATE/GDP		0.0010***	0.0016***	0.0012***	0.0010***
		(0.0003)	(0.0004)	(0.0005)	(0.0003)
$CREDITGRO_{t-2}$		0.0038**	0.0044*	0.0041*	0.0035*
		(0.0019)	(0.0023)	(0.0022)	(0.0019)
DEPOSITINS				0.5859**	0.5131**
				(0.2786)	(0.2582)
No. of crises	77	75	65	65	75
Observations	1670	1612	1356	1356	1612
% total correct	67	70	70	68	68
% crises correct	60	60	58	62	61
% no-crises correct	67	70	70	68	69
Pseudo-R2	0.07	0.08	0.09	0.10	0.08
Chi-sq	216.07***	230.12***	307.22***	348.28***	248.72***
AIC	593	579	494	493	579

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table II. Banking Crises Dates and Durations by Country

Country	Crisis Episodes 1980-2002
Algeria	1990-1992
Argentina	1980-1982, 1989-1990, 1995, 2001-2002*
Benin	1988-1990
Bolivia	1986-1988, 1994-1997**, 2001-2002*
Brazil	1990, 1994-1999
Burkina Faso	1988-1994
Burundi	1994-1997**
Cameroon	1987-1993, 1995-1998
Central African Republic	1988-1999
Chad	1992
Chile	1981-1987
Colombia	1982-1985, 1999-2000
Congo, Rep.	1992-2002*
Congo, Dem. Rep.	1994-2002*
Costa Rica	1994-1997**
Cote d'Ivoire	1988-1991
Ecuador	1995-2002*
El Salvador	1989
Finland	1991-1994
Ghana	1982-1989, 1997-2002*
Guinea	1985, 1993-1994
Guinea-Bissau	1994-1997**
Guyana	1993-1995
India	1991-1994**
Indonesia	1992-1995**, 1997-2002*
Israel	1983-1984
Italy	1990-1995
Jamaica	1996-2000
Japan	1992-2002*
Jordan	1989-1990
Kenya	1993-1995
Korea	1997-2002
Lebanon	1988-1990
Liberia	1991-1995
Madagascar	1988-1991**
Malaysia	1985-1988, 1997-2001
Mali	1987-1989
Mauritania	1984-1993
Mexico	1982, 1994-1997
Nepal	1988-1991**
Níger	1983-1986**
Nigeria	1991-1995
Norway	1987-1993
Panama	1988-1989
Papua New Guinea	1989-1992**
Paraguay	1995-1999

Country	Crisis Episodes 1980-2002
Peru	1983-1990
Philippines	1981-1987, 1998-2002*
Portugal	1986-1989
Senegal	1983-1988
Sierra Leone	1990-1993**
South Africa	1985
Sri Lanka	1989-1993
Swaziland	1995
Sweden	1990-1993
Taiwan	1997-1998
Tanzania	1988-1991**
Thailand	1983-1987, 1997-2002*
Tunisia	1991-1995
Turkey	1982, 1991, 1994, 2000-2002*
Uganda	1994-1997**
United States	1980-1992
Uruguay	1981-1985, 2002*
Venezuela	1993-1997

Notes:
*The crisis is still ongoing as of 2005.
**The end date for the crisis is not certain, a four-year duration is assumed.

Table III. Estimated Crisis Probabilities – Actual vs. Forecast Data

Estimated crisis probabilities are as given in Demirguc-Kunt and Detragiache (2000). They define four fragility zones, increasing in the level of fragility, based on type I and type II errors. The probability intervals for each zone are: Zone I, 0.000-0.018; Zone II, 0.018-0.036; Zone III, 0.036-0.070; Zone IV, 0.070-1.000.

Banking crisis	Estimated Crisis Probabilities	
	Based on Actual Data	Based on Forecast Data
Jamaica (1996)	11.0	6.0
Indonesia (1997)	14.4	2.4
Korea (1997)	4.4	2.3
Malaysia (1997)	3.7	1.8
Philippines (1997)	5.9	3.5
Thailand (1997)	13.8	3.3

Data Appendix

VARIABLE NAME	DEFINITION	SOURCE
BANKING CRISIS	Dummy variable that equals one if there is a banking crisis and zero otherwise.	1998 list updated by the authors using Caprio and Klingebiel (2002) and IMF country reports.
GROWTH	Rate of growth of real GDP	WDI
TOT CHANGE	Change in the terms of trade	WDI
REAL INTEREST	Nominal interest rate minus the contemporaneous rate of inflation	IFS: Nominal interest rate is the treasury bill rate (line 60c), or if not available is the discount/bank rate (line 60), or if not available is the deposit rate (line 60l) WDI: (GDP Deflator Based) inflation rate
INFLATION	Rate of change of GDP deflator	WDI
FISCAL BALANCE/GDP	Budget surplus scaled by GDP	The variable is IFS Line 80, Govt finance:deficit (-) or surplus (+) (loc currency) divided by GDP (loc. cur., WDI).
M2/RESERVES	Ratio of M2 to international reserves	IFS: M2 is money plus quasi money (Current LCU, lines 34+35) which is converted to US$ and divided by total foreign exchange reserves of the central bank (US$)
DEPRECIATION	Rate of depreciation	IFS: Dollar/local currency exchange rate (line ae)
CREDIT GROWTH	Rate of growth of real domestic credit to the private sector	Growth in IFS line 32d divided by the GDP deflator (WDI)
PRIVATE/GDP	Ratio of private credit to GDP	Domestic credit to the private sector (IFS line 32d) divided by GDP (WDI) (all in local currency)
GDP/CAP	Real GDP per capita	WDI: constant 1995 in thousands of US$
DEPOSITINS	Dummy that equals one if the country has explicit deposit insurance (including blanket guarantees) and zero otherwise for the given year.	Updated Demirguc-Kunt and Detragiache (1998) figures using Demirguc-Kunt, Kane, and Laeven (2004)